

Green Energy for your Home ~ A Series ~ Part 4

We previously discussed load analysis, battery selection, solar panels and solar charge controllers, while briefly touching on the subject of those mysterious boxes called inverters. I would now like to talk a little about safe practices, both how to work safely and how to make sure your work is safe for others.

In the inimitable style of David Letterman's Top Ten List here is a selection of what I consider the most important safety considerations when you design, install and operate your own power company.

1. Grounding and Earthing

Electrical installations connected to the grid require grounding. Electricians under rules set out by the Canadian Electrical Code install grounding circuits. Off-grid remote homes often have more casual arrangements such as portable generators that have an internal ground. But when you begin to string wires and attach them to power distribution devices like inverters that are permanent fixtures you must install proper grounding for shock protection. The term earthing refers to the connection of solar panel frames, mounting structures and equipment cases to an earth ground for the purpose of dissipating high energy from lightning strikes. The earthing ground may be the same or different from the electrical ground. It's a complicated subject, seek professional advice before installing.

2. Battery Ventilation

Batteries must be installed in an enclosure and vented to the outside. Lead acid batteries give off sulfuric fumes and generate hydrogen gas when charging. Do not minimize the importance of proper ventilation. For small battery enclosures a passive vent exiting near the top of a battery box with a slanted lid is recommended. Larger batteries need a powered vent with a backdraft preventer. Sulfuric fumes from improperly installed batteries will corrode metal and damage equipment. Hydrogen gas will accumulate into explosive concentrations.

3. Tight Connections

Conductive wires using soft metals such as copper, aluminum and lead have a tendency to creep or flow under pressure over time. Metal creep will result in loose connections that will generate heat and a serious electrical hazard. Tighten connections carefully and then go back and re-tighten them. Even after a few minutes a seemingly tight connection can stand another turn of the screw. Regular maintenance checks should involve checking tightness of connections. Loose connection points on battery terminals will prevent the batteries from doing their job and a spark hazard will exist that can have an explosive result in the presence of hydrogen gas.

4. Battery maintenance

Proper battery maintenance procedures are essential for getting the maximum life out of an expensive battery. For most people this is the single most onerous task in an off-grid power system. Simplify this job by setting up

a regular monthly schedule and stick to it. A poorly maintained battery will not only cost you dearly in shortened life expectancy but will become sulfated and when charging will release higher levels of sulphur dioxide a poisonous gas. Checking the specific gravity of battery electrolyte using a hydrometer is a regular requirement. You will need to suck some of the sulphuric acid from the cells with the hydrometer and it's easy to splash or spill if you're not careful. Wear eye protection and gloves and have clear running water available in case of an accident. Baking soda neutralizes acid spills.

5. Wire selection

Selecting the right wire for your circuits is important for several reasons. Undersized wire will result in line losses and reduced efficiency of your system. Once again there is the second price tag, the first price you pay for the wire, the second price you pay in loss of power over time. A wire that is too small for the job will create resistance to the flow of electricity and that resistance becomes heat. Badly undersized wire will become very hot and cause a fire hazard. Direct current from your batteries requires larger gauge wire than alternating current from your inverter. Also, improperly used wire, e.g. interior wire used outside, will be dangerous. Seek professional advice when choosing wire, there are many factors to consider.

6. Climbing

Solar panels are usually mounted on a roof or pole mount in this region. Ground mounts are less common as we want to avoid hazards from wildlife, livestock and vehicles. Ladders are something we may use on a regular basis but moving heavy solar panels or racking components up a ladder is a difficult and dangerous undertaking. Just today I spoke to a man whose wife was injured in a fall when the base of their ladder slipped and she tumbled off; he was already on the roof and had to jump off to help her. Tie off your ladder; make sure you have a spotter at the bottom to hold it. The 4 to 1 rule should be used when placing the ladder. Set it so that the base is one foot away from what the ladder leans against for every 4 feet in height to where the ladder rests. Don't carry heavy loads up a ladder hoist them up.

7. Overloading equipment

The inverter is a device that will take the DC current from the battery and change it to AC current that your household loads require. Inverters have a nameplate rating in watts, e.g. 2500 watts. Most inverters have surge capacity to accommodate larger loads for a few seconds or minutes. If you subject an inverter rated at 2500 watts to a larger load, say 4500 watts, for an extended period of time you will usually burn up the inverter or it will shut down. Cheaper inverters usually just quit... forever. If you are overloading the inverter you may also be overloading the wire. Cheap inverters that have built in plugs are particularly susceptible to these problems, as users want to plug in everything they can into the extension cord or plug bar. Not only will your inverter overheat and fail, the loads you are using may be subject to lower than required voltage, shortening their life.

8. Lightning

Proper grounding and earthing will reduce the hazard potential of lightning strikes but lightning arrestors installed on both the DC and AC side of your circuits are essential. Proper installations include at a minimum an AC arrestor and DC arrestors on the solar or wind charge controller and on the battery circuit. It is not well understood that transient spikes and surges from lightning strikes even miles away are capable of creating problems. Electronic computer circuitry in your components and household equipment is particularly at risk. Purchase high quality arrestors or don't even bother.

9. Mounting structures

Solar panels or wind generators should be securely mounted to withstand weather and sustained wind forces for many years. A pole mount holding an array of solar panels is just like a sail in the wind and is subject to tremendous forces. Pole mounts require finished steel pipe set several feet into the ground and anchored in concrete. The pipe has to be a large enough diameter or you will be picking your broken panels off the ground. My six panel array has a five inch schedule 40 thick wall steel pipe set six feet in the ground. Raise roof mounts two or three inches above the roof to allow circulation of air behind the panels or heat will rapidly degrade performance and create a fire hazard. Wind generators should be mounted at least 15' above competing structures like buildings and trees and the towers secured to anchors in the ground. All structures need to follow proper grounding procedures. Guy wires on wind towers should be well marked if located in a traffic area.

10. Neutral bonding

Electrical wiring has three conductors, a hot, a neutral and a ground. In an on-grid home these wires are bonded together at the main distribution panel. Off-grid homes don't always have a conventional distribution panel. Often the inverter panel is the point of distribution and it is there that the ground and neutral should be bonded. If you do have a conventional distribution panel then do not bond the neutral and ground at the inverter as two bonding points are not safe. Portable generators often have a floating neutral. This subject is too technical for this brief article but again, seek professional advice for your particular situation ... your lights may come on but your safety may be jeopardized.

As always, if you have specific questions you'd like to ask please feel free to email me at: info@solareagle.com. The complete series of articles is available at our website: <http://www.solareagle.com>

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